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would exert a very considerable influence on the lunar surface; render possible the existence of many substances that appear to constitute a great portion of that surface; and explain many selenographical observations of great interest, that at present appear to point to some such solution, and thus support the hypothesis of the existence of a definite lunar atmosphere.

10th June, 1873.

On the Determination of Longitudes by Moon Culminations.
By Asaph Hall, Esq.

(*Communicated by J. W. L. Glaisher, Esq.*)

The method of determining longitudes by Moon culminations is so simple in theory and so easy of application, that when only an approximate value of the longitude is desired, this method will often be applied. In case, however, we wish an accurate determination of a geographical position, such as may be necessary for a station occupied in observing the Transit of *Venus*, it is well that we should not over-estimate the accuracy of this method. In many of the estimates that have been made we have an illustration of what is frequently happening, viz. the oversight of the existence of constant errors which render such estimates of accuracy wholly illusory. It is customary to determine the probable error of observing the transit of the Moon's limb over a single wire, by comparing the transits among themselves, to do this also for a fixed star, and then by combining these probable errors to determine the probable error of the observed difference of right ascension. Performing this calculation for the two stations, we have, by known rules, the probable error of the resulting longitude; and if our assumptions were correct, we could, by increasing the number of observations, reduce the error of the longitude to as small a quantity as we please. Experiment, however, shows that this is impossible. In nearly all the determinations of longitude by Moon culminations, where a large number of culminations have been observed, the computed probable error of the result is only a small fraction of a second; but the telegraphic determinations of the same points show errors in the old determinations of two, three, and even four seconds of time. Thus the longitude of San Francisco, determined from 206 Moon culminations, was found to be four seconds in error. The most decisive experiment on this point is the determination of longitude between Europe and America. The three determinations of longitude between Greenwich and Washington by the U. S. Coast Survey, by means of the Atlantic cables, give the difference of longitude, $5^h\ 8^m\ 12^s{\cdot}2$. The following are the determinations of the same difference of longitude by Moon culminations:

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Authority.	No. Culminations.	Longitude.	Error.
		h m s	s
Loomis	150	5 8 9·3	− 2·9
Gilliss	394	5 8 10·0	− 2·2
Walker	..	5 8 9·6	− 2·6
Newcomb	279	5 8 11·6	− 0·6
Newcomb	163	5 8 9·8	− 2·4

In his last determination Professor Newcomb used the observations of 1862 and 1863, when the transits both at Greenwich and Washington were recorded by the chronographic method. It seems, therefore, fair to conclude that a longitude determined by Moon culminations may be in error two or three seconds, even if we could use an infinite number of observations.

In 1855 and 1856 an attempt was made at Cambridge, Massachusetts, by Professors Bond and Peters, to determine the difference of longitude between the observatories of Harvard College and Cloverden by observing Moon culminations. In order to secure greater accuracy in the result, a well-defined spot in the Moon, *Messier*, was observed instead of the Moon's limb. It was found that the transits of this spot could be observed with as much accuracy as those of a fixed star. The resulting difference of longitude was $3^{s}{\cdot}54$, while the triangulation gave $1^{s}{\cdot}65$, showing an error of nearly two seconds in the longitude, arising from the presence of some constant error in the observations.

The results of the chronometric expeditions conducted by Struve, Airy, and Bond, show that longitudes determined in this manner are decidedly superior in accuracy to those found from the observations of Moon culminations. The values of the difference of longitude between Greenwich and Washington found by Professor Bond are as follows :

	Longitude.		Error.
	h m s	s	s
1849, '50	5 8 11·6	±0·29	− 0·6
1851	5 8 11·9	±0·25	− 0·3
1855	5 8 13·0	±0·19	+ 0·8

In conclusion, I remark that, so far as I have seen, nearly all the determinations of longitude between Greenwich and Washington which have been derived from Moon culminations, occultations of stars by the Moon, and solar eclipses, give the difference of longitude *smaller* than the telegraphic value, $5^{h}\ 8^{m}\ 12^{s}{\cdot}2$, which I have assumed to be the true value.

Washington, 1873, *May* 1.

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